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ABSTRACT

A study determined the degree of importance secondary vocational instructors place on students' possessing science skills for successful completion of their vocational program. It also determined the specific skills in biology, chemistry, and physics the instructors taught and identified the secondary vocational programs that require students to possess significant science-related skills to complete the program successfully. A list of major science competencies possessed by students who completed beginning biology, chemistry, and physics courses was developed. Questionnaires were designed to determine the degree to which science-related skills must be performed to complete various vocational programs successfully. Of 376 questionnaires sent, 247 were returned. Data were summarized, analyzed, and condensed into three tables. Findings indicated a wide variance in the importance of science-related skills necessary for secondary vocational program completion; they also showed that certain secondary vocational programs do contain a significant component of science-related skills. (Three tables show the biology, chemistry, and physics skills in secondary vocational programs and high importance ratings and percent taught for the various agriculture, business and office education, marketing and distributive education, health, and home economics programs. The questionnaire is appended.) (YLB)

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ED259219

Research Report
EXECUTIVE SUMMARY

THE IDENTIFICATION OF SCIENCE COMPETENCIES INCLUDED IN THE CURRICULUM OF SECONDARY VOCATIONAL EDUCATION PROGRAMS

by
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Mr. Robert Boddy, Research Technician

Prepared for the

Colorado State Board for Community Colleges
and Occupational Education
Occupational Division

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INTRODUCTION

During recent years, the attention focused on public education has increased tremendously. Numerous reports have made recommendations concerning the nature and content of the high school curriculum. Many schools have responded to this new trust by increasing the academic requirements for high school graduation. A study recently completed, which was the first phase of this project, found that increased academic requirements for graduation have an adverse effect on enrollments in vocational programs.

It has been a premise of vocational educators for a number of years that many vocational programs have strong components in certain traditional academic areas. In many instances, secondary schools and colleges have recognized this and accepted these courses for meeting academic requirements for graduation or entrance into postsecondary education. However, until recently, no data were available to determine the specific basic academic skills that were an integral part of the various secondary vocational programs.

A study by Greenan[1] in 1983 dealt with skills that were generalizable in math, communications, interpersonal relations, and reasoning in secondary vocational programs in Illinois. However, science related skills were not included in the study. The study reported here was designed to collect similar data in the science area. With this data, educators will be in a position to determine those secondary vocational programs that include science related skills as a part of their curriculum. Among other things, this information will be valuable in determining whether certain secondary vocational programs can be utilized in meeting part of the graduation requirements or postsecondary entrance requirements in science.

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1 Greenan, James P. "Identification of Generalizable Skills in Secondary Vocational Programs." Department of Vocational Technical Education, University of Illinois, 1983.

The project director wishes to express his appreciation to the State Board for Community Colleges and Occupational Education (SBCCOE) staff and advisory committee members (Appendix A) for their support and assistance in conducting the study. Appreciation is also extended to Mr. Robert Boddy, research technician, for his help in collecting and analyzing the data. A special thanks goes to Ms. Connie Mondragon for editing and typing the manuscript.

OBJECTIVES

This study was conducted with the following objectives in mind:

1. To determine the degree of importance that secondary vocational instructors place on students possessing specific biology, chemistry, and physics related skills to successfully complete their vocational program

2. To determine the specific skills in biology, chemistry, and physics that are taught by vocational instructors in the various secondary vocational programs

3. To identify the secondary vocational programs that require students to possess significant science related skills to successfully complete the program

PROCEDURES

The following procedures were utilized in conducting this study:

1. An advisory committee was assembled to provide guidance and direction to the study (Appendix A)

2. A review of the Illinois study (Greenan) and related literature was conducted

3. A list of the major science competencies possessed by students who completed beginning courses in biology, chemistry, and physics was developed

4. A questionnaire (Appendix B) was designed to determine the degree to which science related skills must be performed to successfully complete various vocational programs. A scale of one to seven was utilized, with one corresponding to "no importance" and a seven indicating "very important." The questionnaire was also designed to determine the degree to which these skills are actually being taught in the various vocational programs

5. An up-to-date list of all credentialed secondary vocational instructors in the state of Colorado was obtained from the SBCCOE

6. The questionnaires were sent to instructors in the vocational service areas of agriculture, business and office, health, home economics, marketing and distributive education, technical education, and trade and industrial education. Only the specific programs in each service area that had at least five programs were included. If more than 20 programs were identified in an area, a random sample was utilized so that no more than 20 or less than five instructors in a specific program area was utilized

7. A total of 376 questionnaires were sent. Of that number, 247 were returned. This represented a 65.7 percent return rate

8. The data from the questionnaires were summarized and analyzed. Means and standard deviations were calculated for each skill in each specific program area. Since a seven-point importance scale was utilized, the mean scores were divided into three categories. A mean score of 5.00 to 7.00 was assigned a high importance rating. A mean score of 3.00 to 4.99 was assigned a medium importance rating, and mean scores below 3.00 were assigned a low importance rating

   Instructors responded to the question of whether each specific skill was actually taught in their program by indicating a simple yes or no. If at least two-thirds of the instructors responded with a yes, the skill was assigned a high rating. If at least one-third, but less than two-thirds, of the instructors responded with a yes, the skill was assigned a medium rating. If less than one-third of the instructors responded with a yes, the skill was assigned a low rating

9. The data were condensed and are presented in Tables 1-3 utilizing the procedure mentioned above

FINDINGS

The major findings of this study include:

1. A wide variance in the importance of science related skills necessary for completion among the various programs in secondary vocational education was found

2. Certain secondary vocational programs do contain a significant component of science related skills

3. Specific secondary vocational programs that contain significant components of biology related skills are: production agriculture, horticulture, dental assistant, nursing assistant, allied health, consumer homemaking, and multi-occupational home economics (Table 1)

4. Specific secondary vocational programs that contain significant components of chemistry related skills are: production agriculture, horticulture, dental assistant, nursing assistant, commercial art, and auto mechanics (Table 2)

5. Specific secondary vocational programs that contain significant components of physics related skills are: production agriculture, horticulture, auto mechanics, small engine repair, drafting, and electronics technology (Table 3)

6. Science related skills are not an important component of the curriculum in business and office education and marketing and distributive education

TABLE KEY AND ABBREVIATIONS

Key

Mean - $\bar{x}$

■ High = 5.00 - 7.00

◪ Medium = 3.00 - 4.99

□ Low = 1.00 - 2.99

Percent Taught - %

● 67 to 100 percent

◑ 33.3 to 66.7 percent

○ 0 to 33.2 percent

Abbreviations

AG	-	Agriculture
HORT	-	Horticulture
BOE	-	Business and Office Education
MDE	-	Marketing and Distributive Education
DA	-	Dental Assistant
NA	-	Nursing Assistant
AH	-	Allied Health
CH	-	Child Care
HMO	-	Multi-Occupational Home Economics
HC	-	Homemaking/Consumer
FM	-	Food Management
CA	-	Commercial Art
COS	-	Cosmetology
AB	-	Auto Body
AM	-	Auto Mechanics
SE	-	Small Engine Repair
BL	-	Bricklaying
CARP	-	Carpentry
CONS	-	Construction Trades
DR	-	Drafting
MACH	-	Machine Shop
ELEC	-	Electronics Technology
WEL	-	Welding
GR	-	Graphic Arts

TABLE 1a. Biology skills in secondary vocational programs.

Biology Skills	Agriculture				BOE		MDE		Health						Home Economics							
	AG		HORT						DA		NA		AH		CH		HMO		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
1. Understand the basic names, characteristics, structures, and theories of animal or plant cells.	■	◑	◪	●	□	○	□	○	◪	◑	■	●	◪	●	□	○	◪	○	◪	○	□	○
2. Have an advanced knowledge of animal or plant cells.	◪	○	◪	◑	□	○	□	○	◪	○	◪	◑	◪	◑	□	○	□	○	□	○	□	○
3. Use a microscope to classify objectives or differentiate between animal and plant cells.	◪	○	◪	●	□	○	□	○	◪	○	◪	○	◪	◑	□	○	□	○	□	○	□	○
4. Seed, plant, cultivate, or look after plants, shrubs, or trees.	■	●	■	●	□	○	□	○	□	○	◪	○	□	○	□	○	◪	○	◪	○	□	○
5. Understand and use the terms and theories of plant life and reproduction.	■	●	■	●	□	○	□	○	◪	○	◪	○	□	○	◪	○	◪	○	◪	○	□	○
6. Have a knowledge of human skeletal, muscular, and body systems.	◪	○	□	○	□	○	□	○	■	◕	■	●	■	●	◪	○	■	◑	◪	●	□	○
7. Understand the basic terms and theories related to disease.	■	●	◪	◑	□	○	□	○	■	●	■	●	■	●	◪	●	■	●	◪	●	◪	●
8. Have a knowledge of nutrients and the processes of the digestive system.	■	●	◪	◑	□	○	□	○	■	●	■	●	■	●	◪	●	■	●	■	●	■	●
9. Have a basic knowledge and understand advanced concepts of heredity.	■	●	■	◑	□	○	□	○	◪	◑	◪	◑	◪	●	◪	○	◪	●	■	●	□	○
10. Understand the physical characteristics, feeding, breathing, and reproduction methods of various classes of animals.	■	●	◪	◑	□	○	□	○	◪	○	◪	○	◪	◑	◪	○	◪	○	◪	◑	□	○

TABLE 1b. (continued)

Biology Skills	Technical and Trade																									
	CA		COS		AB		AM		SU		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
1. Understand the basic names, characteristics, structures, and theories of animal or plant cells.	□	○	◪	●	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
2. Have an advanced knowledge of animal or plant cells.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
3. Use a microscope to classify objects or differentiate between animal and plant cells.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
4. Seed, plant, cultivate, or look after plants, shrubs, or trees.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
5. Understand and use the terms and theories of plant life and reproduction.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
6. Have a knowledge of human skeletal, muscular, and body systems.	■	●	■	●	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
7. Understand the basic terms and theories related to disease.	□	○	■	●	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
8. Have a knowledge of nutrients and the processes of the digestive system.	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
9. Have a basic knowledge and understand advanced concepts of heredity.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
10. Understand the physical characteristics, feeding, breathing, and reproduction methods of various classes of animals.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○

TABLE 2a. Chemistry skills in secondary vocational programs.

Chemistry Skills	Agriculture				BOE		MDE		Health						Home Economics							
	AG		HORT						D		NA		AH		CH		HMO		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
1. Have a basic knowledge of matter.	◪	○	◪	◑	□	○	□	○	◪	○	◪	○	◪	○	□	○	◪	○	◪	○	□	○
2. Understand and use basic concepts of buoyancy.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	◪	◑	□	●	□	○
3. Determine the specific gravity of objectives or liquids.	◪	○	□	○	□	○	□	○	◪	○	□	○	◪	●	□	○	□	○	□	◑	□	○
4. Solve buoyancy, floatation, and displacement problems.	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
5. Understand and use the laws and principles relating to gases.	◪	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	◪	○	□	◑	□	○
6. Prepare gases (gases which mix with another, but do not combine chemically).	◪	◑	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
7. Understand and use basic terms, methods, theories, and principles relating to heat.	◪	◑	□	○	□	○	□	○	◪	◑	□	○	□	◑	□	○	◪	○	◪	○	◪	○
8. Solve problems relating to heat.	■	○	◪	◑	□	○	□	○	◪	○	□	○	□	○	□	○	□	◑	◪	●	□	◑
9. Understand and use basic terms, chemical properties theories, and concepts related to acids and bases.	■	●	■	◑	□	○	□	○	◪	◑	◪	○	□	◑	□	●	□	○	□	◑	□	○
10. Use indicators to identify or test for the presence of acids or bases.	◪	◑	■	◑	□	○	□	○	□	○	◪	○	◪	◑	□	○	◪	○	□	◑	□	○
11. Measure acidity or alkalinity (pH).	■	◑	■	○	□	○	□	○	□	○	◪	○	◪	●	□	○	□	○	□	○	□	○

TABLE 2b. (continued)

Chemistry Skills	Technical and Trade																													
	CA		COS		AB		AM		SE		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
1. Have a basic knowledge of matter.	◪	●	◪	●	□	○	■	●	◪	●	□	○	□	◑	□	○	◪	◑	□	○	◪	●	◪	◑	◪	◑
2. Understand and use basic conepts of buoyancy.	□	○	□	○	□	○	◪	◑	□	◑	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	○
3. Determine the specific gravity of objectives or liquids.	◪	○	□	○	□	○	■	●	◪	●	□	○	□	◑	□	○	□	○	□	○	□	◑	□	○	□	○
4. Solve buoyancy, floatation, and displacement problems.	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
5. Understand and use the laws and principles relating to gases.	□	○	□	○	□	○	□	◑	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	◪	○	□	○
6. Prepare gases (gases which mix with another, but do not combine chemically).	□	○	□	○	□	○	□	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	◪	◑	□	○
7. Understand and use basic terms, methods, theories, and principles relating to heat.	◪	●	□	○	□	○	■	●	◪	●	□	○	◪	◑	◪	◑	◪	◑	□	○	◪	◑	◪	◑	□	○
8. Solve problems relating to heat.	◪	○	□	○	◪	○	◪	○	◪	○	□	○	□	○	□	○	◪	○	◪	○	□	○	◪	◑	□	○
9. Understand and use basic terms, chemical properties theories, and concepts related to acids and bases.	◪	○	◪	●	□	○	□	◑	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	◑	◪	●
10. Use indicators to identify or test for the presence of acids or bases.	◪	◑	◪	●	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	■	●
11. Measure acidity or alkalinity (pH).	□	○	■	●	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	■	●

TABLE 2c. (continued)

Chemistry Skills	Agriculture				BOE		MDE		Health						Home Economics							
	AG		HORT						DA		NA		AH		CH		HMG		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
12. Understand and use basic terms, properties, theories, and concepts related to water and solutions.	◪	○	◪	○	□	○	□	○	◪	○	◪	○	◪	●	□	○	◪	○	□	◑	□	○
13. Prepare or test water and solutions for a particular purpose or use.	◪	○	◪	○	□	○	□	○	□	○	◪	○	◪	◑	□	○	◪	○	□	○	□	○
14. Understand and use terms related to compounds mixed with water.	◪	◑	◪	○	□	○	□	○	◪	◑	◪	○	□	◑	□	○	□	○	◪	○	□	○
15. Understand and use molecular atomic theory and the concept of the atom.	◪	○	◪	○	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○
16. Understand the use of the periodic table of elements.	◪	○	◪	○	□	○	□	○	□	○	◪	○	□	○	□	○	□	○	□	○	□	○
17. Understand and explain the characteristics of halogens.	◪	○	◪	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	○
18. Understand the characteristics of metals.	■	●	◪	◑	□	○	□	○	◪	◑	□	○	□	○	□	○	◪	○	◪	◑	□	○
19. Understand and use the basic terms, characteristics, and formulae related to hydrocarbons.	◪	○	◪	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	○
20. Understand and use basic terms, laws, formulae, calculations, and tests relating to chemical reactions.	◪	○	◪	○	□	○	□	○	□	○	◪	○	□	○	□	○	□	○	◪	◑	□	○
21. Use various types of lab equipment.	◪	◑	◪	◑	□	○	□	○	◪	◑	■	◑	■	●	□	○	◪	◑	◪	◑	□	○
22. Understand and use safety precautions in all laboratory situations.	◪	●	■	◑	□	○	□	○	◪	◑	◪	○	■	●	◪	●	◪	◑	■	●	◪	●

TABLE 2d. (continued)

Chemistry Skills	Technical and Trade																											
	CA		COS		AB		AM		SE		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
12. Understand and use basic terms, properties, theories, and concepts related to water and solutions.	◪	●	◪	◑	□	○	◪	◑	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	■	●
13. Prepare or test water and solutions for a particular purpose or use.	◪	○	□	○	□	○	□	◑	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	■	●
14. Understand and use terms related to compounds mixed with water.	◪	●	■	◑	□	○	□	○	□	○	◪	◑	◪	◑	□	○	□	○	□	○	□	○	□	○	□	●
15. Understand and use molecular atomic theory and the concept of the atom.	□	○	□	○	□	○	■	◑	■	◑	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	○
16. Understand the use of the periodic table of elements.	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	◪	●	□	○	□	○
17. Understand and explain the characteristics of halogens.	□	●	◪	○	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	◑
18. Understand the characteristics of metals.	□	◑	□	○	□	○	◪	●	◪	○	□	○	◪	◑	□	○	◪	●	■	●	◪	●	■	●	◪	◑
19. Understand and use the basic terms, characteristics, and formulae related to hydrocarbons.	□	○	□	○	□	○	◪	◑	◪	○	□	○	□	◑	□	○	□	○	□	○	□	○	□	○	□	○
20. Understand and use basic terms, laws, formulae, calculations, and tests relating to chemical reactions.	◪	●	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	■	○	□	○	◪	○
21. Use various types of lab equipment.	□	●	□	○	◪	○	◪	●	□	●	□	○	□	◑	□	○	□	○	□	○	■	●	□	○	□	○
22. Understand and use safety precautions in all laboratory situations.	■	●	□	◑	■	●	◣	●	■	●	■	○	◪	◑	■	●	◪	○	◪	●	■	●	■	●	◪	●

TABLE 3a. Physics skills in secondary vocational programs.

Physics Skills	Agriculture				BOE		MDE		Health						Home Economics							
	AG		HORT						DA		NA		AH		CH		HMO		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
1. Have the basic knowledge and understand basic terms, theories, and laws concerning the concept of force, work, power, and energy.	■	◑	◪	○	□	○	□	○	◪	◑	□	○	□	○	□	○	◪	◑	□	◑	□	○
2. Solve problems involving force, work, power, and energy.	◪	◑	◪	◑	□	○	□	○	◪	◑	□	○	□	○	□	○	◪	◑	□	◑	□	○
3. Draw force (vector) diagrams to determine the forces acting on an object.	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
4. Determine and express the difference between static and dynamic energy.	◪	○	◪	○	□	○	□	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○
5. Solve simple motion problems including distance, rate, and time.	◪	◑	◪	○	□	○	□	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○
6. Understand and use terms related to motion.	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
7. Construct, read, and interpret time displacement graphs.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	◑	□	○	□	○
8. Understand and use the concept of "Frame of Reference."	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
9. Understand simple terms relating to vibratory motion and sound.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
10. Understand complex terms relating to vibratory motion and sound.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○

TABLE 3b. (continued)

Physics Skills	Technical and Trade																											
	CA		COS		AB		AM		SE		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ	$\bar{x}$	Σ
1. Have the basic knowledge and understand basic terms, theories, and laws concerning the concept of force, work, power, and energy.	□	○	□	○	◪	○	■	●	■	●	□	○	◪	●	□	○	■	○	◪	●	■	●	◪	◑	□	○
2. Solve problems involving force, work, power, and energy.	□	○	□	○	◪	●	■	◑					◪	●	□	○	◪	○	□	◑	■	●	◪	◑	□	○
3. Draw force (vector) diagrams to determine the forces acting on an object.	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	○	◪	○	□	○	■	●	□	○	□	○
4. Determine and express the difference between static and dynamic energy.	□	○	□	○	□	○	◪	●	◪	●	□	○	□	◑	□	○	◪	○	□	○	■	●	□	○	□	○
5. Solve simple motion problems including distance, rate, and time.	□	○	□	○	□	○	◪	●	◪	●	□	○	□	○	□	○	◪	○	□	○	◪	●	□	○	□	○
6. Understand and use terms related to motion.	◪	●	□	○	□	○	◪	●	■	●	□	○	□	◑	□	○	◪	○	□	○	◪	◑	□	○	□	○
7. Construct, read, and interpret time displacement graphs.	□	○	□	○	□	○	◪	◑	□	○	□	○	□	○	◪	○	◪	○	□	○	◪	◑	□	○	□	○
8. Understand and use the concept of "Frame of Reference."	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	■	◑	□	○	□	○
9. Understand simple terms relating to vibratory motion and sound.	◪	◑	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	◪	○	□	○	■	●	□	○	□	○
10. Understand complex terms relating to vibratory motion and sound.	□	○	□	○	□	○	□	◑	□	○	□	○	□	○	□	○	◪	○	□	○	■	●	□	○	□	○

TABLE 3c. (continued)

Physics Skills	Agriculture				BOE		MDE		Health						Home Economics							
	AG		HORT						DA		NA		AH		CH		HMO		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
11. Understand concepts relating to vibratory motion and sound.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
12. Use magnets, including magnet keepers and electromagnets.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	○	□	○	□	○
13. Understand and use concepts and terms relating to magnets and electromagnets.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
14. Illustrate or describe electromagnets and magnetic fields.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
15. Explain or demonstrate the operating principle of a magnetic compass.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
16. Understand and use concepts relating to static electricity.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
17. Understand and explain the relevance of atomic numbers.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
18. Understand and use basic electric cells (batteries), circuits, terms, and circuit diagrams relating to electricity.	■	◑	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	◑
19. Solve problems in electrical circuits by measuring or calculating voltage, current, or resistance.	■	◑	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
20. Understand and use electronic terminology.	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○

TABLE 3d. (continued)

Physics Skills	Technical and Trade																											
	CA		COS		AB		AM		SE		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
11. Understand concepts relating to vibratory motion and sound.	□	○	□	○	◪	●	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	○
12. Use magnets, including magnet keepers and electromagnets.	□	○	□	○	□	○	■	●	■	●	□	○	□	◑	□	○	◪	○	□	○	◪	●	□	○	□	○
13. Understand and use concepts and terms relating to magnets and electromagnets.	□	○	□	○	□	○	■	●	■	●	□	○	□	○	□	○	◪	○	□	○	■	●	□	○	□	○
14. Illustrate or describe electromagnets and magnetic fields.	□	○	□	○	□	○	■	●	■	●	□	○	□	◑	□	○	◪	○	□	○	■	●	□	○	□	○
15. Explain or demonstrate the operating principle of a magnetic compass.	□	○	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	■	◔	□	○	□	○
16. Understand and use concepts relating to static electricity.	◪	◑	◪	○	□	○	◪	◑	◪	●	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	◑
17. Understand and explain the relevance of atomic numbers.	□	○	□	○	□	○	□	◑	□	◑	□	○	□	○	□	○	□	○	□	○	■	◑	□	○	□	○
18. Understand and use basic electric cells (batteries), circuits, terms, and circuit diagrams relating to electricity.	□	◑	□	○	◪	○	■	●	■	●	□	○	◪	◑	□	○	◪	◑	□	○	■	●	□	◑	□	○
19. Solve problems in electrical circuits by measuring or calculating voltage, current, or resistance.	□	○	□	○	◪	○	■	●	■	●	□	○	◪	◑	□	◑	◪	○	□	◑	■	●	□	○	□	○
20. Understand and use electronic terminology.	□	○	□	○	◪	○	■	●	■	●	□	○	◪	◑	□	○	◪	●	□	○	■	●	□	○	□	○

TABLE 3e. (continued)

Physics Skills	AG		HORT		BOE		MDE		Health						Home Economics							
									DA		NA		AN		CH		HMO		HC		FM	
	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$	$\bar{x}$	$\tilde{x}$
21. Draw and/or read schematic diagrams and discuss the characteristics of the devices used in the circuit.	◪	◑	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
22. Understand and explain methods by which electromagnetic waves are produced.	◪	○	□	○	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○
23. Identify wavelength in the electromagnetic spectrum of A.M. radio, F.M. radio, television, and lasers.	□	○	◪	○	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○
24. Understand and explain the operating principles of radio and radar transmission and reception.	◪	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
25. Understand and use basic concepts, laws, and diagrams relating to reflection and refraction of light.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	◑	□	○
26. Understand and use the basic laws, theories, and the spectra of color.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	◪	◑	◪	●	□	○
27. Read and/or write very large or small numbers using scientific notation.	■	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○
28. Convert from English to metric systems or vice versa.	■	●	◪	◑	□	○	□	○	◪	◑	■	◑	■	●	□	○	◪	●	■	◐	□	○
29. Solve problems concerning length, area, and volume using both English and metric systems.	■	●	■	●	□	○	□	○	◪	◑	◪	○	◪	○	□	○	■	◑	■	●	□	○
30. Identify levers by classes and parts.	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○

TABLE 3f. (continued)

Physics Skills	Technical and Trade																									
	CA		COS		AB		AM		SE		BL		CARP		CONS		DR		MACH		ELEC		WEL		GR	
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
21. Draw and/or read schematic diagrams and discuss the characteristics of the devices used in the circuit.	□	○	□	○	■	●	■	●	■	●	□	○	◪	◑	◪	●	■	●	□	○	■	●	□	○	□	○
22. Understand and explain methods by which electromagnetic waves are produced.	□	○	□	○	□	○	◪	◑	□	○	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	○
23. Identify wavelength in the electromagnetic spectrum of A.M. radio, F.M. radio, television, and lasers.	□	○	□	○	□	○	◪	○	□	○	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	○
24. Understand and explain the operating principles of radio and radar transmission and reception.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	■	●	□	○	□	○
25. Understand and use basic concepts, laws, and diagrams relating to reflection and refraction of light.	■	●	□	○	◪	○	□	○	□	○	□	○	□	◑	□	○	◪	○	□	○	■	●	□	○	■	◔
26. Understand and use the basic laws, theories, and the spectra of color.	■	●	□	◑	■	●	□	○	□	○	□	○	□	○	□	○	◪	○	□	○	■	●	□	○	■	●
27. Read and/or write very large or small numbers using scientific notation.	□	○	□	○	□	○	□	○	□	○	□	○	□	○	□	○	◪	◑	□	◑	■	●	□	○	□	○
28. Convert from English to metric systems or vice versa.	◪	●	□	○	■	●	■	●	◪	●	□	○	◪	◑	◪	◑	■	●	■	●	■	●	◪	●	◪	◑
29. Solve problems concerning length, area, and volume using both English and metric systems.	■	●	□	○	■	●	◪	●	◪	●	◪	●	■	●	■	●	■	●	■	●	■	●	◪	●	◪	◑
30. Identify levers by classes and parts.	□	○	□	○	□	○	◪	◑	◪	●	□	○	□	○	□	○	□	○	□	○	■	○	□	○	◪	◑

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. School districts should consider utilizing vocational courses that contain significant science components in their curriculum as an alternative for meeting a portion of the science requirements for graduation

2. Since some variation was observed in the amount of science taught by the vocational instructors in the specific vocational program areas, local school districts should review the extent of the science skills taught in each of their program areas before utilizing specific vocational courses for meeting graduation requirements in science

3. Since many vocational courses require students to possess basic skills in either biology, physics, or chemistry, schools should consider scheduling options that will place students in these classes prior to the completion of the vocational program

APPENDIX A

ADVISORY COMMITTEE

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APPENDIX B

QUESTIONNAIRE

SCIENCE RELATED SKILLS IN VOCATIONAL EDUCATION

The purpose of this questionaire is to determine the extent that science related skills are taught by the vocational instructors in secondary vocational programs in agriculture, business and office, marketing and distributive education, home economics, health occupations, and trade & technical occupations.

In the spaces provided indicate the name of your institution, write your name, check (✓) your particular vocational service area, and specify the training program for which you provide instructions.

Institution _____

Teacher's Name _____

Program Service Area (check one)

( ) Agriculture ( ) Home Economics ( ) Multi-Occupational

( ) Business and Office ( ) Health Occupations ( ) Special Co-Op

( ) Marketing and Distributive Education ( ) Trade & Technical

Vocational Training Program
Please Specify (e.g., Secretarial, Nursing, Carpentry, Electronics) _____

DIRECTIONS:

A list of basic science related skills is included in this instrument. Your responses should indicate the importance that is placed on these skills to successfully complete your program. Your response may vary from "Not Important" to "Very Important" depending upon the degree of importance you assign to each specific skill in relation to your program.

Please circle the number (1 to 7) that indicates the degree of importance you assign to each specific skill listed. You may add any skill not included in the list and indicate its importance in the spaces provided at the end of each skill area. In the column to the right please indicate whether instruction in the skill is provided as a part of the curriculum in your vocational program by circling either yes or no.

BIOLOGY RELATED SKILLS	DEGREE OF IMPORTANCE (CIRCLE ONE)							INSTRUCTION IN THIS SKILL IS PROVIDED IN THE VOCATIONAL CURRICULUM (CIRCLE ONE)	
	NOT IMPORTANT			MODERATELY IMPORTANT			VERY IMPORTANT		
1. Understand the basic names, characteristics, structures, and theories of animal or plant cells.	1	2	3	4	5	6	7	YES	NO
2. Have an advanced knowledge of animal or plant cells.	1	2	3	4	5	6	7	YES	NO
3. Use a microscope to classify objects or differentiate between animal & plant cells.	1	2	3	4	5	6	7	YES	NO
4. Seed, plant, cultivate, or look after plants, shrubs or trees.	1	2	3	4	5	6	7	YES	NO
5. Understand and use the terms and theories of plant life and reproduction (e.g., pollination, fertilization.	1	2	3	4	5	6	7	YES	NO
6. Have a knowledge of human skeletal, muscular, and body systems.	1	2	3	4	5	6	7	YES	NO
7. Understand the basic terms and theories related to disease.	1	2	3	4	5	6	7	YES	NO
8. Have a knowledge of nutrients and the processes of the digestive system.	1	2	3	4	5	6	7	YES	NO
9. Have a basic knowledge and understand advanced concepts of heredity (e.g., genetics, chromosome theory).	1	2	3	4	5	6	7	YES	NO
10. Understand the physical characteristics, feeding, breathing, and reproduction methods of various classes of animals (e.g., mammals, birds, reptiles, fishes, and insects).	1	2	3	4	5	6	7	YES	NO

	DEGREE OF IMPORTANCE (CIRCLE ONE)							INSTRUCTION IN THIS SKILL IS PROVIDED IN THE VOCATIONAL CURRICULUM (CIRCLE ONE)	
	NOT IMPORTANT		MODERATELY IMPORTANT			VERY IMPORTANT			
11. Other (list) _____	1	2	3	4	5	6	7	YES	NO
12. Other (list) _____	1	2	3	4	5	6	7	YES	NO
13. Other (list) _____	1	2	3	4	5	6	7	YES	NO
CHEMISTRY RELATED SKILLS									
1. Have a basic knowledge of matter (e.g., solids, liquids, & gases).	1	2	3	4	5	6	7	YES	NO
2. Understand and use basic concepts of buoyancy.	1	2	3	4	5	6	7	YES	NO
3. Determine the specific gravity of objects or liquids.	1	2	3	4	5	6	7	YES	NO
4. Solve buoyancy, floatation, and displacement problems.	1	2	3	4	5	6	7	YES	NO
5. Understand and use the laws and principles relating to gases (e.g., Boyle's Law, Charle's Law).	1	2	3	4	5	6	7	YES	NO
6. Prepare gases (gases which mix with another, but do not combine chemically).	1	2	3	4	5	6	7	YES	NO
7. Understand and use basic terms, methods, theories, and principles relating to heat (e.g., conduction, convection, radiation).	1	2	3	4	5	6	7	YES	NO
8. Solve problems relating to heat (e.g., heat of fusion, heat required to reach the melting points of solids).	1	2	3	4	5	6	7	YES	NO
9. Understand and use basic terms, chemical properties theories, and concepts related to acids and bases.	1	2	3	4	5	6	7	YES	NO
10. Use indicators (e.g., litmus paper to identify or test for the presence of acids or bases).	1	2	3	4	5	6	7	YES	NO
11. Measure pH (acidity or alkalinity).	1	2	3	4	5	6	7	YES	NO
12. Understand and use basic terms, properties, theories, and concepts related to water and solutions.	1	2	3	4	5	6	7	YES	NO
13. Prepare or test water and solutions for a particular purpose or use (e.g., consumption, conductivity).	1	2	3	4	5	6	7	YES	NO
14. Understand and use terms related to hydrates (compounds mixed with water).	1	2	3	4	5	6	7	YES	NO
15. Understand and use molecular atomic theory and the concept of the atom.	1	2	3	4	5	6	7	YES	NO
16. Understand the use of the periodic table of elements.	1	2	3	4	5	6	7	YES	NO
17. Understand the characteristics of halogens (flourine, bromine, cholorine, iodine).	1	2	3	4	5	6	7	YES	NO
18. Understand the characteristics of metals.	1	2	3	4	5	6	7	YES	NO
19. Understand and use the basic terms, characteristics, and formulae related to hydrocarbons.	1	2	3	4	5	6	7	YES	NO
20. Understand and use basic terms, laws, formulae, calculations, and tests relating to chemical reactions.	1	2	3	4	5	6	7	YES	NO

	DEGREE OF IMPORTANCE (CIRCLE ONE)							INSTRUCTION IN THIS SKILL IS PROVIDED IN THE VOCATIONAL CURRICULUM (CIRCLE ONE)	
	NOT IMPORTANT		MODERATELY IMPORTANT			VERY IMPORTANT			
21. Use various types of lab equipment.	1	2	3	4	5	6	7	YES	NO
22. Understand and use safety precautions concerning acids and poisions, caustics, flammables, and pressure gases.	1	2	3	4	5	6	7	YES	NO
23. Other (list) _____	1	2	3	4	5	6	7	YES	NO
24. Other (list) _____	1	2	3	4	5	6	7	YES	NO
25. Other (list) _____	1	2	3	4	5	6	7	YES	NO
PHYSICS RELATED SKILLS									
1. Have the basic knowledge and understand basic terms, theories, and laws concerning the concept of force, work, power, & energy.	1	2	3	4	5	6	7	YES	NO
2. Solve problems involving force, work, power, and energy.	1	2	3	4	5	6	7	YES	NO
3. Draw force (vector) diagrams to determine the forces acting on an object.	1	2	3	4	5	6	7	YES	NO
4. Determine and express the difference between static and dynamic energy.	1	2	3	4	5	6	7	YES	NO
5. Solve simple motion problems including distance, rate, and time.	1	2	3	4	5	6	7	YES	NO
6. Understand and use terms related to motion.	1	2	3	4	5	6	7	YES	NO
7. Construct, read, and interpret time displacement graphs.	1	2	3	4	5	6	7	YES	NO
8. Understand and use the concept of "Frame of Reference."	1	2	3	4	5	6	7	YES	NO
9. Understand simple terms relating to vibratory motion and sound (e.g., period, frequency, and amplitude).	1	2	3	4	5	6	7	YES	NO
10. Understand complex terms relating to vibratory motion and sound (e.g., mechanical waves, compression, & expansion).	1	2	3	4	5	6	7	YES	NO
11. Understand concepts relating to vibratory motion and sound (e.g., producing beats, types of sound waves, relationship between frequency, & pitch.	1	2	3	4	5	6	7	YES	NO
12. Use magnets, including magnet keepers and electromagnets.	1	2	3	4	5	6	7	YES	NO
13. Understand and use concepts and terms relating to magnets (e.g., magnetic field, magnetic shield, & saturation).	1	2	3	4	5	6	7	YES	NO
14. Illustrate or describe electromagnets and magnetic fields.	1	2	3	4	5	6	7	YES	NO
15. Explain or demonstrate the operating principle of a magnetic compass.	1	2	3	4	5	6	7	YES	NO
16. Understand and use concepts relating to static electricity (e.g., static charges, movement of electrons).	1	2	3	4	5	6	7	YES	NO
17. Understand and explain the relevance of atomic numbers.	1	2	3	4	5	6	7	YES	NO
18. Understand and use basic electric cells (batteries), circuits, terms, and circuit diagrams relating to electricity.	1	2	3	4	5	6	7	YES	NO

	DEGREE OF IMPORTANCE							INSTRUCTION IN THIS SKILL IS PROVIDED IN THE VOCATIONAL CURRICULUM (CIRCLE ONE)	
	NOT IMPORTANT		MODERATELY IMPORTANT (CIRCLE ONE)				VERY IMPORTANT		
19. Solve problems in electrical circuits by measuring or calculating voltage, current, or resistance.	1	2	3	4	5	6	7	YES	NO
20. Understand and use electronic terms (e.g., transistor, diode, amplification, electron theory).	1	2	3	4	5	6	7	YES	NO
21. Draw and/or read schematic diagrams and discuss the characteristics of the devices used in the circuit.	1	2	3	4	5	6	7	YES	NO
22. Understand and explain method by which electromagnetic waves are produced.	1	2	3	4	5	6	7	YES	NO
23. Identify wavelength in the electromagnetic spectrum of A.M. radio, F.M. radio, television, and lasers.	1	2	3	4	5	6	7	YES	NO
24. Understand and explain the operating principles of radio and radar transmission and reception.	1	2	3	4	5	6	7	YES	NO
25. Understand and use basic concepts, laws and diagrams relating to reflection and refraction of light.	1	2	3	4	5	6	7	YES	NO
26. Understand and use the basic laws, theories, and the spectra of color.	1	2	3	4	5	6	7	YES	NO
27. Read and/or write very large or small numbers using scientific notation (e.g., powers of 10; 3×10^4).	1	2	3	4	5	6	7	YES	NO
28. Convert from the English to Metric systems or vice versa.	1	2	3	4	5	6	7	YES	NO
29. Solve problems concerning length, area, and volume using both the English and Metric systems.	1	2	3	4	5	6	7	YES	NO
30. Identify levers by classes and parts.	1	2	3	4	5	6	7	YES	NO
31. Other (list) _____	1	2	3	4	5	6	7	YES	NO
32. Other (list) _____	1	2	3	4	5	6	7	YES	NO
33. Other (list) _____	1	2	3	4	5	6	7	YES	NO

When completed place in the enclosed envelope, and return to:

Dr. B. Harold Anderson
Dept. of Vocational Education
Colorado State University
Fort Collins, CO 80523